

# Free-running (non-entrained to 24-h period) circadian sleep disorder in a patient with obstructive sleep apnea, delayed sleep phase tendency, and lack of social interaction

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## Introduction

Circadian rhythm sleep disorder, free-running type (FRD) occurs primarily in blind persons who are deprived of the entraining effects of light. It is rare in sighted patients and usually occurs in those who live in environments with low light levels and those working unusual schedules [1]. We report a case of a young man with delayed sleep phase tendency, depression, obstructive sleep apnea (OSA), and near complete lack of social interaction who developed FRD.

## Report of case

A 20-year-old man with history of depression cluster headaches and gout presented for sleep evaluation due to excessive daytime sleepiness. His problems with daytime sleepiness and delayed sleep onset started at age 12. By age 15, he started home schooling due to his problems adjusting with early

rising. At age 18, he was diagnosed with OSA at an outside institution, with apnea–hypopnea index (AHI) of 17/h at that time. Sleep efficiency was 83% and an arousal index was 19/h. He underwent a trial of continuous positive airway pressure (CPAP) therapy; his sleep-disordered breathing was corrected at the pressure of 11 cmH<sub>2</sub>O. A multiple sleep latency test following this full night CPAP titration study showed mean sleep latency of 11.6 min and no sleep onset REM periods. He was prescribed an autoadjusting PAP unit.

Since that evaluation, he has been using his CPAP device every night. He was not working at the time of this evaluation and did not attend high school due to sleep habits. He spent his wake time playing on the computer or watching television. His parents made some attempts to interrupt this schedule, but would frequently find him asleep and not disturb him. Everyday, he went to sleep 1–2 h later than the day prior and woke up after about 7 h of sleep. If his sleep period coincided with daytime, he blocked the windows with blinds. His inactivity was accompanied by a weight gain of 70 lbs over 2 years.

Physical examination showed a disheveled, obese young man (BMI 47.9 kg/m<sup>2</sup>) who had a Mallampati III/IV oropharynx. He described himself as an isolated person and reported having a “more than 24-h sleep cycle”. Epworth Sleepiness Scale score was 9/24. Medications included bupropion, mirtazapine, and nasal budesonide. He had a brother who was 13 years older, who had delayed sleep phase, OSA, and was treated with CPAP.

Patient’s regular use of CPAP for OSA allowed evaluation of his sleep–wake cycle through the examination of recording of the CPAP compliance card [2]. It showed nightly use and confirmed a systematic delay in his sleep phase: in every 24-h period, the CPAP use would start 1–2 h later than the day prior (Fig. 1). Residual AHI was normal at 1.7/h and no large leak was observed.

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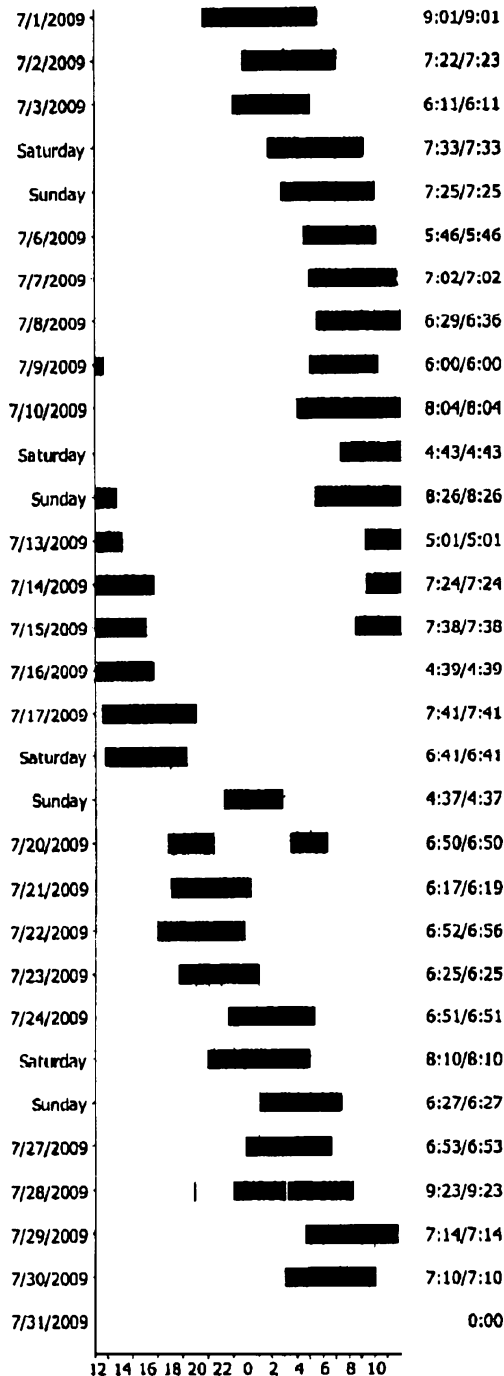
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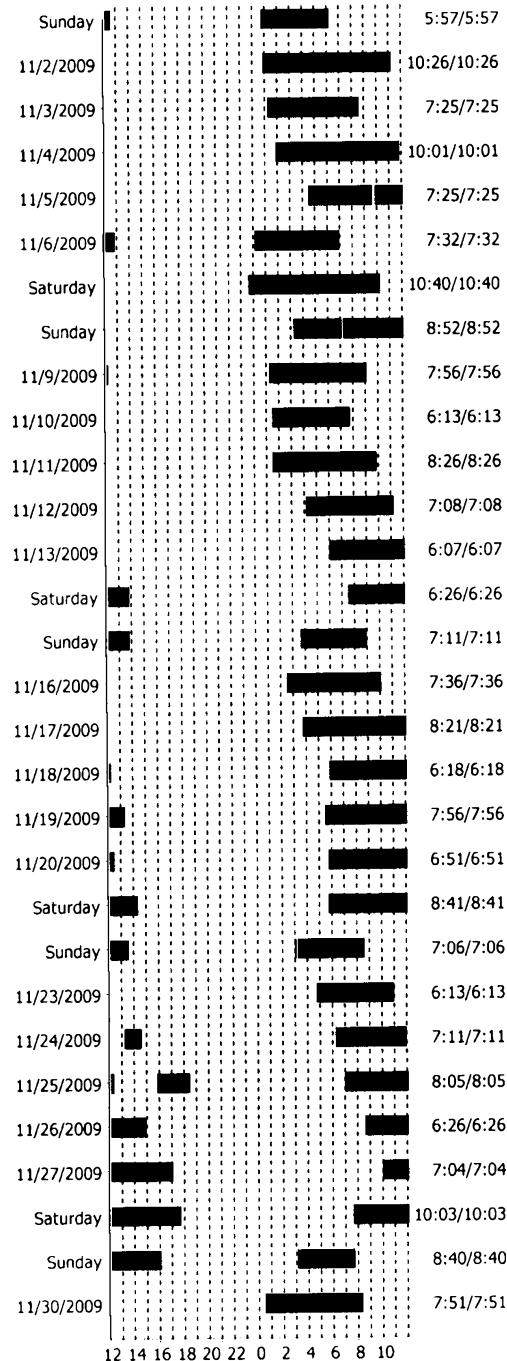
The prescribed treatment was aimed at filling his daytime with activities combined with attempts to keep his sleep schedule regular with a use of bright light and melatonin. He was asked to restart school courses and get a part time job. He was asked to wait with the beginning of treatment until his sleep phase aligns with the desired time of the day and then started using a bright light therapy at

10,000 lux for 30 min after awakening and melatonin 2 mg 2 to 3 h before the planned bedtime [3]. His parents were asked to attend the medical appointments and attempts were made to engage them in this treatment plan.

He initially followed the prescribed plan and enrolled in a local community college which forced him to wake up in the morning. This resulted in entraining to a near 24-h cycle, with a



**Fig. 1** Evaluation of sleep-wake cycle through the examination of recording of the compliance card. Baseline download shows progressive delay in sleep phase



**Fig. 2** Evaluation of sleep-wake cycle through the examination of recording of the compliance card during the trial of bright light and melatonin therapy

significant delayed sleep phase. Interestingly, his consecutive weekdays showed a progressive delay in sleep onset which was corrected in a stepwise manner during weekends (Fig. 2). After one semester of school, he stopped these efforts and reverted to the free-running cycle of 25–26-h duration, again documented by his compliance device.

## Discussion

Free-running circadian sleep disorder is typically a reflection of the natural human circadian period, which is longer than 24 h [4] in an absence of entraining factors. These factors, zeitgebers or time-givers, normally anchor the circadian rhythm; the most important zeitgeber is light but mealtime, exercise, and to lesser extent, social interactions have been shown to entrain the circadian rhythm [5].

Our patient's lack of home, school, or work duties coupled with a near complete lack of social interaction, controlled exposure to daytime light, and tendency towards delayed sleep phase resulted in the development of FRD. With the introduction of social stimuli and treatment with bright light and melatonin he was able to maintain a quasi-24-h schedule for a period of 2 months. Eventually, his comfort with previous lifestyle and lack of motivation or ability to change, it resulted in the return of FRD.

To our knowledge, this is the first report of the concurrent obstructive sleep apnea and FRD. The role of OSA in the development of delayed sleep phase or FRD is

unclear, but is likely coincidental. The patient's lack of social interaction and unwillingness to engage with the treatment process made an appropriate evaluation of his sleep–wake cycle with measurement of the dim light melatonin onset impossible. Our patient was not excessively sleepy as judged by the MSLT or ESS. Compared to previously reported sighted patients with FRD, he had a relatively short average sleep time of 6 h and 50 min. However, the presence of OSA and patient's excellent compliance with CPAP gave us a unique opportunity of looking into patient's sleep–wake cycle by monitoring his compliance card in a continuous manner, comparable to actigraphy.

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